MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

DTC5088 – ANALOG AND DIGITAL COMMUNICATION SYSTEMS

(Diploma in Electronic Engineering)

18 OCTOBER 2018
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **4** pages excluding the cover page and appendix.

2. Answer **ALL** question. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Give the definition of the following systems and provide each of the example signal:

i) Analog communication systems [2 marks]

ii) Digital communication systems [2 marks]

b) Explain **SIX (6)** comparison between the analog communication systems and digital communication systems. [12 marks]

c) For the given signal $x(t)$ in Figure 1, find and sketch the following output:

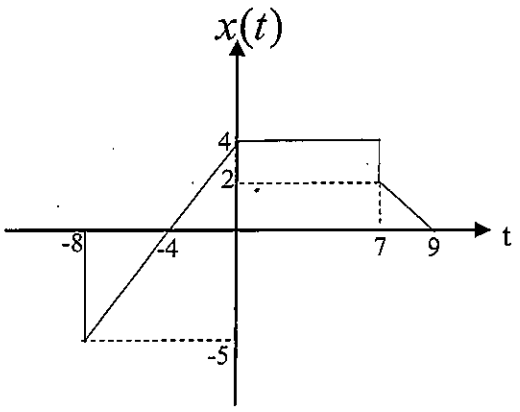

Figure 1

i) $x\left(\frac{4-t}{3}\right)$ [4 marks]

ii) $x(8-t)$ [4 marks]

iii) State the types of the signal operation involved in (ii) [1 mark]

Continued...

QUESTION 2 [25 MARKS]

a) Describe **THREE (3)** types of the analog modulation systems. [6 marks]

b) Briefly explain **TWO (2)** important parameters of a good receiver in communication systems. [4 marks]

c) An FM modulator produces a modulated signal with peak deviation of $\delta = 35\ kHz$ with the modulating signal frequency, $f_m = 50\ kHz$. Given that carrier amplitude, $A_c = 10\ V$ and carrier frequency, $f_c = 300\ kHz$, determine the following:

i) Bandwidth with limitation [2 marks]

ii) Bandwidth without limitation [2 marks]

iii) Frequency spectrum for the Bessel approximation [5 marks]

d) Figure 2 shows the frequency spectrum of a multi-tone signal for IF components. The local oscillator frequency, f_{Lo} is tuned above the RF in the receiver. Find and construct a frequency spectrum for RF components if the receiver has f_{Lo} of 3000 kHz. [6 marks]

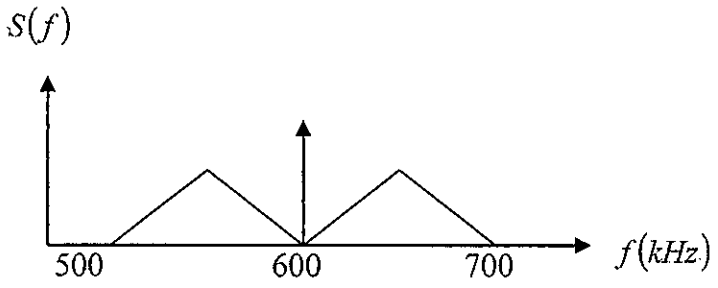

Figure 2

Continued...

QUESTION 3 [25 MARKS]

a) What is the minimum sampling rate if the highest frequency for the analog input is 2300 Hz? [2 marks]

b) An audio signal from digital voice note is created by sampling rate of 45000 sample/s. It is uses a 16-bit Pulse Code Modulation. Calculate the bit rate. [2 marks]

c) Given a set of inputs that from 0 V to 6 V. The data are 1.7 V, 5.7 V and 2.1 V, respectively:

i) Draw the quantized data if the system uses 4-bit quantization level. [2 marks]

ii) Determine the number of bit per sample needed. [2 marks]

iii) Show the binary encoding process and write the binary output stream. [4 marks]

d) For a digital data stream of 01101, draw the modulated signal with bit rate of 5 bps and 5 baud/signal with the modulation scheme of:

i) Amplitude Shift Keying [2 marks]

ii) 2 – Phase Shift Keying [2 marks]

e) Calculate the bitrate if the baud rate given is 10 kbaud/second when modulated using:

i) 4 –Phase Shift Keying [2 marks]

ii) 8 –Quadrature Amplitude Modulation [2 marks]

iii) Frequency Shift Keying [2 marks]

f) Draw the constellation diagram for 16 –Quadrature Amplitude Modulation with 3 levels of amplitude and 12 phases. [3 marks]

Continued...

QUESTION 4 [25 MARKS]

a) Briefly explain why we need digital to digital conversion. [2 marks]

b) Sketch 1100000110 according to the following line coding scheme:

i) Unipolar. [2 marks]

ii) High-Density Bipolar 3. [2 marks]

iii) Alternate Mark Inversion. [2 marks]

c) Show the difference between Non Return Zero Level and Non Return Zero Inverted coding using a proper sketch. Assume the input data is 101010. [4 marks]

d) In a digital communication system that use hamming code, if the receiver received 10101010110 and it is has single bit error, show:

i) How the system detects the error and which position the error occurs? [8 marks]

ii) State the correct data. [2 marks]

e) If in a data transmission, the total bits transmitted is 3. Determine the redundancy bit, r and the actual number of data bits, m. [3 marks]

End of Page.

APPENDIX

(A) Amplitude Modulation

Carrier signal, $s_c(t) = A_c \cos(\omega_c t)$

Modulating signal, $s_m(t) = A_m \cos(\omega_m t)$

Amplitude-modulated signal,

DSB-LC: $s(t) = A_c \cos\omega_c t + \frac{A_m}{2}\cos(\omega_c - \omega_m)t + \frac{A_m}{2}\cos(\omega_c + \omega_m)t$

DSB-SC: $s(t) = \frac{A_m A_c}{2}\cos(\omega_c + \omega_m)t + \frac{A_m A_c}{2}\cos(\omega_c - \omega_m)t$

SSB-SC:

LSB : $s_{LSB}(t) = \frac{A_m A_c}{2}\cos(\omega_c t - \omega_m t)$

USB : $s_{USB}(t) = \frac{A_m A_c}{2}\cos(\omega_c t + \omega_m t)$

(B) Frequency Modulation

$$\begin{aligned}\phi_{FM} = {} & A_c J_0(m_f)\sin\omega_c t + \\ & A_c\left(J_1(m_f)(\sin(\omega_c + \omega_m)t - \sin(\omega_c - \omega_m)t)\right) + \\ & A_c\left(J_2(m_f)(\sin(\omega_c + 2\omega_m)t - \sin(\omega_c - 2\omega_m)t)\right) + \\ & A_c\left(J_3(m_f)(\sin(\omega_c + 3\omega_m)t - \sin(\omega_c - 3\omega_m)t)\right) + \\ & A_c\left(J_4(m_f)(\sin(\omega_c + 4\omega_m)t - \sin(\omega_c - 4\omega_m)t)\right) + \\ & A_c\left(J_5(m_f)(\sin(\omega_c + 5\omega_m)t - \sin(\omega_c - 5\omega_m)t)\right) + \ldots + \\ & A_c\left(J_n(m_f)(\sin(\omega_c + n\omega_m)t - \sin(\omega_c - n\omega_m)t)\right)\end{aligned}$$

Bessel table function

Modulation Index (m_f)	Carrier Frequency J_0	n or order of sidebands J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}	J_{11}	J_{12}	J_{13}	J_{14}	J_{15}	J_{16}
0.00	1.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	—	—	—	—	—	—	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—	—	—	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—	—	—	—	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02	—	—	—	—	—	—	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—	—	—	—	—	—	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02	—	—	—	—	—	—
8.0	0.17	0.23	−0.11	−0.29	−0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03	—	—	—	—	—
9.0	−0.09	0.24	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.30	0.21	0.12	0.06	0.03	0.01	—	—	—
10.0	−0.25	0.04	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.31	0.29	0.20	0.12	0.06	0.03	0.01	—	—
12.0	0.05	−0.22	−0.08	0.20	0.18	−0.07	−0.24	−0.17	0.05	0.23	0.30	0.27	0.20	0.12	0.07	0.03	0.01
15.0	−0.01	0.21	0.04	−0.19	−0.12	0.13	0.21	0.03	−0.17	−0.22	−0.09	0.10	0.24	0.28	0.25	0.18	0.12

Source: E. Cambi, *Bessel Functions*, Dover Publications, Inc., New York, N.Y., 1948. Courtesy of the publisher.

(C) AM Superheterodyne Receiver

Local oscillator frequency,

$$f_{LO} = f_{RF(C)} + f_{IF(C)}$$

$$f_{LO} = f_{RF(USF)} + f_{IF(LSF)}$$

$$f_{LO} = f_{RF(LSF)} + f_{IF(USF)}$$